

**KTC**

**1998**  
**Annual Report**

**Kentucky Transportation Center**  
College of Engineering 1 University of Kentucky

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### *Advisory Board*

James C. Codell III Kentucky Transportation Secretary	Patricia V. Durbin Elizabethtown, Ky.	Sandy Lee Watkins Judge-Executive Henderson County
J. M. (Mac) Yowell State Highway Engineer	Brad M. Meyer Haworth, Meyer & Boleyn	David R. Martin Judge-Executive Butler County
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	Anna Dale Pyles Dover, Ky.	Buddy Smith Paducah, Ky.

### *Former Directors*

Calvin G. Grayson 1988-1997	James H. Havens 1963-1980	D. V. Terrell 1941-1957
Robert C. Deen 1981 - 1988	William B. Drake 1957-1963	

## *Ron Hughes Retires After Serving the Center Almost 50 Years*

People in the work force in the nineties move around a lot in their careers trying to find just the right job that will make them happy and that pays well. When they think they have found it, they work a few years, grow tired of the work or decide they can do better elsewhere, and move on. With access to the Internet, potential employees have choices around the globe as never before, so having many jobs on one's resume after a few years of work is not uncommon. But the person who embraces a career with an organization and stays with it almost 50 years is very rare indeed. **Ronald D. Hughes** is just such an individual. His career of 47 years and 4 months has been with one organization—although it changed hands once and changed names more than once. Ron contributed his engineering expertise and training to what is now the Kentucky Transportation Center at the University of Kentucky, where he retired on September 30, 1998, as Associate Director.



*Ron Hughes*

### *His Engineering Career*

While a student at the University of Kentucky, Ron began working for the Kentucky Transportation Cabinet (then called the Kentucky Department of Highways) as an engineering aid for various divisions during the summers. Upon graduation in 1955, with a bachelor of science degree in civil engineering, he worked as assistant research engineer in the Division of Research. Ron went on to earn a master of science degree in civil engineering in 1957 while working for the Division. He worked in various positions until 1976 when he became assistant to the director. Ron saw many changes at the Division, as it became part of the University of Kentucky on January 1, 1981, when he was appointed deputy director. More changes were in store for the Division in 1988, as it combined with the Technology Transfer Unit in UK's College of Engineering to become the current Kentucky Transportation Center. With that change, Ron was appointed associate director and served in that capacity until his retirement.

Ron is good-natured, has a wry sense of humor, and a tremendous institutional knowledge of the Center, the Transportation Cabinet, and the University of Kentucky. He will be especially missed though for his transportation engineering expertise. He always has been available to answer questions, solve engineering problems, to add his know-how to a lab project, or to help remember a report, an event, or even a person from the Center's past. His areas of engineering expertise and interest include pipe and box culvert design (hydraulics and structural), durability of reinforced concrete structures and pavements, preparation of 1) guidance and training manuals, and 2) standard specifications and special provisions. One of Ron's hobbies is gardening. The Center staff knows of his "green thumb" and considers him an expert to answer gardening questions. During breaks, they picked his brain for needed information on planting tomatoes, spinach, carrots, and other vegetables and flowers.

The Center thanks Ron Hughes for the valuable expertise and hard work he has provided the Center during his career! His fellow employees and friends wish him a delightful retirement, one in which he stays healthy and productive, and one in which he and his wife, Shirley, can enjoy their two children. We know that Ron will continue his agricultural research during his retirement (he was our resident "green thumb") and we will miss that advice and his wealth of knowledge.

## *Message from the Director*

### *The Value of Innovation*

Improving transportation in the Commonwealth is the focus of our mission at the Kentucky Transportation Center. The transportation business, like most all businesses, is changing and the successes of the past have little relevance on the future. While we are part of the business world's service sector, we don't have the benefit of a stock market bottom-line gauge. Our effort to use business-like approaches for improved effectiveness includes continually assessing the needs of our customers, our product quality, and our delivery system.

It is our responsibility to be on the cutting edge of technology so that our recommended state-of-the-art solutions allow for the most productivity with the least cost. We take calculated risks on new technology in the laboratory, we make educated guesses when all the information is not available, and we make careful assessments about deployment for our customers. We are at the heart of the Commonwealth's transportation research and development (R&D) investment and subsequent transfer of technology statewide.

Meeting the challenges of the future requires change—we investigate new roadway materials for quality, durability, and cost-effectiveness; we design and test new bridge structures; we design and operationally test intelligent transportation systems to reduce traffic congestion, provide better traveler information, and improve commercial vehicle safety; and we examine policy and planning alternatives that can improve decision-making and public involvement. Not every research project or study represents a giant step forward, and sometimes we learn more from our occasional failures. Such is the nature of risk and payoff in R&D for all business sectors.

Much of the past success in both government and industry rests upon the amount of good research that has been conducted and has paid off. We believe that those who invest in R&D today will be the leaders in the new century. Unfortunately, we have seen the total resources dedicated to national transportation research diminish. This is not good government business. We must invest in transportation R&D at the national and state levels to remain competitive in the global economy. Economic development is not guaranteed by good transportation but is absolutely hindered by the lack of it. Every dollar invested in transportation R&D returns benefits that exceed it to those who use and depend on Kentucky's transportation system. It's just good business. And, it's what we do everyday.

This year's Annual Report is the first of our abbreviated annual reports that will be published every other year--the year that the Kentucky General Assembly does not meet in full session. A more detailed, comprehensive Annual Report will be published in the years it does meet. This report reflects the Center's efforts and belief in "The Value of Innovation."



*Paul E. Toussaint*

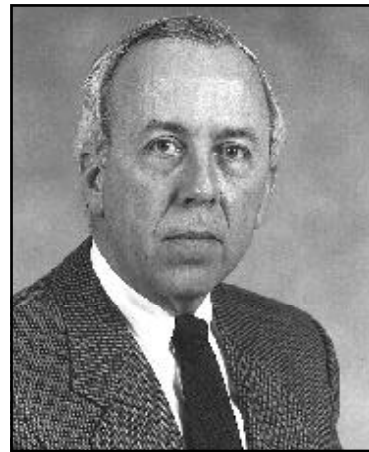
Paul E. Toussaint, Director

## *Message from the Transportation Secretary*

We at the Kentucky Transportation Cabinet enjoy a unique relationship with the Kentucky Transportation Center at the University of Kentucky. Many state transportation agencies do not have immediate access to expert research and study resources that can augment or supplement their capabilities. From quick-response studies to coordinating long-term demonstration initiatives, the Center has provided needed support to the Cabinet.

A major example of our partnership success has been in the area of Intelligent Transportation Systems focused on commercial vehicles. Working together, we have been able to assist other states and receive substantial additional federal resources in an effort to improve the efficiency of commercial vehicle operations on the roadside/deskside. It was gratifying to have our partnership with other states and the Center recognized nationally with the receipt of the 1998 ITS America award for outstanding achievement in commercial vehicle operations.

With partners like the Center, the Kentucky Transportation Cabinet will meet the challenges of the future. We sincerely appreciate the outstanding work performed by the Center on behalf of the Kentucky Transportation Cabinet.



*James C. Codell III*

James C. Codell III, Kentucky Transportation Secretary

### *The Road to Quality*

The Center is committed to improving the quality of its services and its internal efficiency and effectiveness. Several teams have been created to identify and implement needed improvements at the Center. The ***Education and Training (E.A.T.) Team*** has accomplished its goals of encouraging staff training and finding training resources, and will meet as needed. The E.A.T. Team developed an "Orientation and Reference Manual" to provide a convenient and easily understood administrative guide for current and new staff at the Center. Several other Teams remain active, including the following:

**m *Continuous Improvement Team***—To oversee our progress.

**m *Paperwads Team***—To identify ways of eliminating unnecessary paperwork and streamlining administrative processes. The work of this team has already resulted in improvements to logging out/returning state vehicles, updating and keeping current the Engineering College's email list, streamlining the biweekly time sheets, and reorganizing the copy room at the Center. The team is currently working on streamlining internal forms and making them accessible electronically.

**m *Marketing Team***—To establish guidelines and direction for marketing the Center. The team has already addressed the annual report, web site, research briefs, and other publications and reports. They also oversaw the development of a new Center logo. The team has contracted with a local marketing agency to conduct an image survey that should provide information on where and how to focus marketing strategies to enhance the Center's research and technology transfer services.

## ***Abbreviated History***

- The Road Materials Testing Laboratory was established in 1914 at the University of Kentucky by Professor D. V. Terrell.
- In 1928, testing services were transferred to the Kentucky Department of Highways in Frankfort. Some research, however, continued at the University.
- The Kentucky Department of Highways moved its Division of Research to UK's campus in 1941 and operated the Division until 1980. The entire research program was transferred that year, contracting with UK to carry out the basic research program.
- On July 1, 1984, the Center was designated a Technology Transfer Center by the Federal Highway Administration (FHWA) to serve as a transportation extension service to Kentucky's local governments.
- The Kentucky Transportation Research Program and the Center's Technology Transfer Program operated as separate entities under the College of Engineering until 1988, when they merged to become the current Kentucky Transportation Center.
- The Advanced Transportation Institute (now called Transportation Systems Management Program), established at the Center in 1989, offers a post-baccalaureate certificate in transportation system management. The Center is a major participant in the consortium of University Transportation Centers in the southeast region.

## ***Overview***

### **Technology Transfer**

- The Center serves as Kentucky's Local Technical Assistance Program (LTAP) providing services and technology linkage to local governments. The Technology Transfer Program also provides services to state government employees, private industry employees, as well as others involved in transportation in Kentucky.
- Services include training programs, on-site assistance, a lending library (the only transportation library in the state), nontechnical publications, and newsletters.

### **Research**

- The Center's comprehensive program of transportation research includes Environmental Analysis, Geotechnology, Intelligent Transportation Systems, Pavements, Policy and Impact Analysis, Structures, Traffic and Safety, and Strategic Change Integration.
- The benefits of research conducted through the years by the Cabinet and the Center have been significant. Information gained from the Center's research has affected transportation standards and methodologies, as well as provided solutions to difficult problems.

### **Experiential Education**

- To provide students with real-world preparation, the Transportation Systems Management Program (formerly called Advanced Transportation Institute) offers a unique combination of academic study and hands-on application. The highly successful interdisciplinary approach draws students from areas such as civil engineering, geography, and business administration. Students completing the program are employed by a wide range of transportation related agencies and businesses.

*The Center's building has been named by the UK Board of Trustees in honor of Oliver H. Raymond, UK College of Engineering graduate and benefactor. The Center's address is now: 176 Raymond Building, University of Kentucky, Lexington, KY 40506-0281.*

# **REVIEW OF ACTIVITIES**

## **FY 1997-'98**

*The following pages present the Center's  
technology transfer, research, and experiential  
education activities during the fiscal year  
July 1, 1997, to June 30, 1998.*



UNIVERSITY OF KENTUCKY  
COLLEGE OF ENGINEERING

## KENTUCKY TRANSPORTATION CENTER

### ***Our Mission***

*We provide services to the transportation community  
through research, technology transfer, and education.  
We create and participate in partnerships to promote safe  
and effective transportation systems*

### ***We Value. . .***

*Teamwork--listening and communicating  
along with courtesy and respect for others.  
Honest and ethical behavior.  
Delivering the highest quality products and services.  
Continuous improvement in all that we do.*



*For more information, contact us at:*

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University of Kentucky  
Lexington, KY 40506-0281

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*The University of Kentucky is an Equal Opportunity Organization*



## ***Technology Transfer***

Since 1984, the Center's Technology Transfer Program has been delegated the task of obtaining the latest information, methods, and innovations from across the United States and beyond to transfer to Kentucky's transportation community.

Center staff use the following tools to accomplish that task:

- 1 A training program for all levels of transportation employees.
- 1 Publications, including newsletters, handbooks, and directories.
- 1 An information service featuring a state-of-the-art library.
- 1 On-site technical assistance and demonstrations.

To deliver these services, the Center maintains an extensive mail list of transportation providers and users. A toll-free phone number is available for client use.

The following pages highlight the major technology transfer activities conducted during fiscal year 1997-1998.

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### ***Technology Transfer in Action!***



*When the Technology Transfer Unit learns of new and innovative processes that local governments have discovered or invented, it passes that information on through its newsletter, The Link. Boone County Road Supervisor Harvey Pelley devised a means of reducing the cost of building retaining walls/erosion control blankets by fabricating blocks from a waste material called "concrete type." In this photo, which appeared in an article about the process in the Spring 1998 issue of The Link, Mike Utz (right) and Steve Bayer give the backhoe operator directions as a block is aligned for the retaining wall being constructed along a creek in Boone County.*

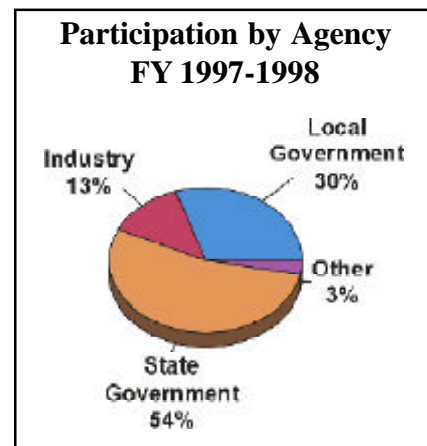
## Technology Transfer (T<sup>2</sup>)

One of the best measures of technical assistance efforts is the number of training sessions/workshops completed during the year. Among the 57 LTAP centers across the nation, the most recent tabulation revealed that the average number of workshops presented during calendar year 1997 was 44, whereas, Kentucky LTAP presented 99. Kentucky was only exceeded by California, Florida, Texas, and Washington State. Work Zone Traffic Control and Flagger training continues to be the workshop most often presented in Kentucky, with 31 contributing to the total count that year.

The following lists the Technology Transfer Unit activities during Fiscal Year 1997-'98.

### Training

- ◆ Total attendance at the Center's 124 workshops/training sessions during FY '97-'98 was 4,131.
- ◆ Training was conducted in 32 locations across the state, with the largest number of workshops being held in the cities of Lexington, Frankfort, Louisville, and Bowling Green.
- ◆ New courses include: Erosion Control, Geometric Design, and Maintenance of Utility Cuts.
- ◆ Special workshops/seminars include the 33rd Annual Transportation Forum and the second annual Snow and Ice Conference.
- ◆ The largest increase in workshop attendance this year was state employees. Those employees made up 54 percent of workshop participants, up from 38 percent during FY '96-'97.
- ◆ This year's 39 new Roads Scholars bring the total to 122 local and state governmental agency employees who have earned the designation through a special training program.
- ◆ The Transportation Hall of Fame Selection Committee inducted Calvin G. Grayson into the Hall of Fame. Previous inductees include: Henry T. Ward, Buckner Hinkle Sr., Cyrus Layson, Dwight H. Bray, C. M. "Hank" Hancock, and Otto Ingram.
- ◆ Working with the Transportation Cabinet, Federal Highway Administration, and the Plant-Mix Asphalt Industry of Kentucky, the Center continued to offer training for qualification as Plant Technologist and Mix Design Technologist. Three courses for the prerequisite Plant Technologist certified 34 people from the state and 27 from industry. The Mix Design Technologist class certified 25 people. Total number of certifications over the three years of the training is 491.



### Publications and Mailings

- ◆ Technology Transfer staff is working on a Work Zone Traffic Control Guidelines for High-Volume Facilities that will be published in late 1998.
- ◆ Published four editions of the Center's LTAP (Local Technical Assistance Program)

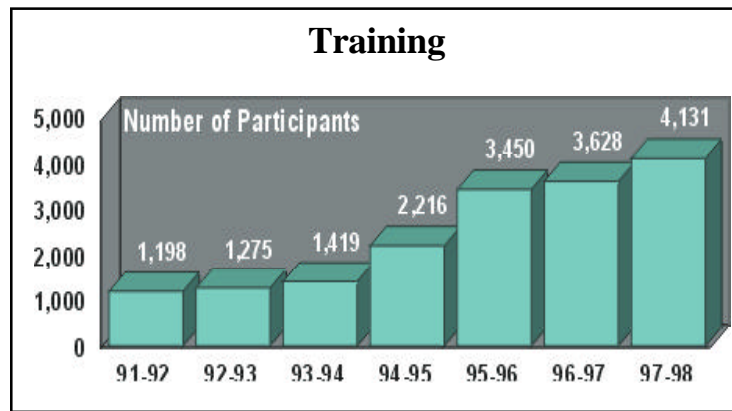
newsletter, *The Link*, including a special edition on the Center's training opportunities.

- ◆ Publication staff developed web pages for the Technology Transfer Unit. To view the T<sup>2</sup> web

pages, click on *Technology Transfer* on the Center's Internet site: <<http://www.engr.uky.edu/ktc>>.

- ◆ The Technology Transfer staff conducted two research projects this fiscal year:

1. *County Road Finance for 1996-97* -- A statistical summary of 118 of 120 Kentucky counties reporting on revenues received and payments made as related to their roadways.
2. *Customer Satisfaction Survey* -- This study included a telephone survey of 625 Kentucky highway users, and a mail survey sent to elected officials and commercial drivers to form a base opinion on the performance of the Kentucky Department of Highways.



## Library

- ◆ Attendance at the Library totaled 6,447 patrons, including UK staff and students, and some Kentucky state and local government personnel.

- ◆ Circulation of materials was 1,721 which included videos, periodicals, and books. By far, the most popular materials circulated are videos.

- ◆ The Library's Information Service provided answers to inquiries ranging from pavement management to traffic safety issues, as well as questions on bridges, asphalt, concrete, and soils. In addition, people management has become a topic of interest. There were 860 reference questions. Phone questions totaled 233, most from state and local governments.

- ◆ The Library added 858 new volumes to its collection of 18,000 materials.



*At the 1997 Snow and Ice Conference, the newest Kentucky DOH vehicle was demonstrated showing how chemicals can be distributed in a variety of forms (liquid and solids)*

## Other Activities

- ◆ The Technology Exchange Unit changed its name *back* to Technology Transfer.

## ***Research***

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The benefits of the Center's transportation research throughout the years have been significant. Valuable data and records have been collected and developed for a multitude of studies that have been conducted in the general area of transportation.

The vast majority of studies have produced solutions to pressing problems, led to more effective utilization of materials and mixtures, and enhanced overall operations within the Kentucky Transportation Cabinet, the Center's main research sponsor.

Research conducted for the Cabinet and other entities has covered a broad spectrum of topics and has ranged from very short-term, problem-solving studies to long-term, developmental studies.

Listed on the following pages are the Center's research divisions and many of the research projects that hold the promise of providing significant savings as well as improved construction or safety standards for the Commonwealth.

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### ***Research in Action!***

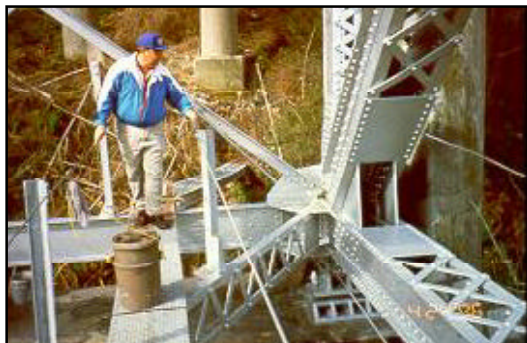


*Research activities conducted in the Center's Structures Section have led to innovative deployment of advanced fiber-reinforced polymer (FRP) composites technology to infrastructure applications. This new material will be one of the construction materials in the next century. While attending the Wilson Composites Forum in Lexington in June 1998, engineers from the United States and Europe visited the Clear Creek Bridge, the longest composite girder bridge in the world. The design, testing, fabrication, and construction of the bridge, located near Cave Run Lake in Daniel Boone National Forest in Bath County, were accomplished by researchers at the Center.*



## *Environmental Analysis*

This Section works to apply new, cost-effective technologies to a wide range of situations impacting transportation. Section personnel team with clients to fully understand present situations, identify opportunities for improvement, formulate plans to instigate changes, plan actions to implement those modifications in an orderly manner, and assess the impacts of those actions to ascertain that maximum benefits were achieved. A prominent example of this approach is the bridge maintenance painting program of the Kentucky Transportation Cabinet (KyTC). The Center's Environmental Analysis Section staff have a key role in teaming with Cabinet officials to develop a painting program that has received national recognition for low costs and technical innovation.



*Ted Hopwood, Environmental Analysis Section Head, inspects a bridge overcoated with an environmentally friendly paint system.*

### **Current Research**

◆ ***Stream Mitigation Modeling and Assessment*** - The Transportation Cabinet initiated this research to ensure that its stream mitigation projects are performing correctly. Center staff are inspecting these projects to ascertain their current status. Also, stream performance models will be reviewed to determine whether they can be of use during the design process.

◆ ***Development of Procedures for Reducing Public Opposition to Highway Construction*** - Issues related to public

opposition to highway construction are being identified. Procedures for addressing those concerns are being investigated.

- ◆ ***Evaluation of the Service Performance of Bridge Components*** - The performance of common bridge components are being evaluated to identify performance-enhancing revisions.
- ◆ ***Bridge Maintenance Painting*** - A major experimental bridge painting project is the painting of the John F. Kennedy Bridge (I-65), Louisville. Other experimental projects will be used to evaluate new paint systems. Section personnel will assist KyTC officials with coatings development, problem resolution, and certification training of inspectors.
- ◆ ***Development of an Information Management System for Assisting KyTC Personnel Concerning Environmental Issues*** - Section personnel will assist with maintenance of the Transportation Environmental Information Management System (TEIMS) that has been installed on KyTC servers for routine use.
- ◆ ***Creation of a Regional State Highway Agency Working Group to Advance Bridge Maintenance and Inspection Practices*** - In conjunction with the Northwestern University Infrastructure Technology Institute, Section personnel are conducting meetings with officials from five state highway agencies to identify better bridge maintenance and inspection practices.



*Center staff inspect streambed to determine performance.*

## Geotechnology

The Geotechnology Section conducts research on soil and rock materials used in the construction and maintenance of transportation facilities. Implementation of past research performed by this Section has created new ways of building highways in Kentucky and has saved millions of dollars. Also, past geotechnical engineering testing, field techniques, and design standards

developed, or promoted, and introduced by the Geotechnology Section are used routinely by Kentucky highway engineers. Some examples of these major innovative programs include:



*Geotechnology staff use laser technology to construct slope cross sections for analysis.*

- ◆ Stabilization of highway pavement soil subgrades to improve pavement performances.
- ◆ Laboratory and field methods of identifying the engineering properties of shales and finding ways of using shales of poor engineering quality in constructing highways.
- ◆ Shale compaction specifications that have led to a significant reduction of slope and settlement failures in new highway embankments.
- ◆ Highway rock slope management program that identifies hazardous rock slopes.
- ◆ Mathematical models and personal computer programs for analyzing the bearing capacity of highway pavements, rock slopes, embankment slopes, and retaining structures.
- ◆ A statewide geotechnical database in a client/server environment that will be useful in planning new highways and the economical development of Kentucky.

## Current Research Studies

- ◆ Correlation of Observed Rock Scour (around bridge foundations founded on rock) with Preconstruction Rock Quality.
- ◆ Stress in Highway Pavement Subgrades and Relationships between Resilient Modulus and Soil Indices.
- ◆ Development of a Landslide Inventory Program.
- ◆ Highway Rock Slope Risk Management System.
- ◆ Examination of Economic Methods for Repairing Landslides.
- ◆ Development of a Statewide Geotechnical Database.
- ◆ Benefits of Stabilizing Highway Pavement Subgrades.
- ◆ Development of a Trans. Planning Model for I-66 in the London-Corbin-Somerset Area.

## Laboratories and Equipment

The Geotechnology Section maintains two fully equipped laboratories and field equipment. The laboratories are accredited by the American Association of State Highway and Transportation Officials (AASHTO) Materials Reference Laboratory (AMRL) and they are fully equipped for performing routine and specialized tests on soils, rocks, and aggregates. Testing facilities include equipment for performing classification, gradation, compaction, bearing ratio, routine and very specialized triaxial testing, resilient modulus, consolidation, permeability, slake durability, relative density, LA abrasion, and sulfate soundness testing. Automated computer systems are used to obtain data in many of the various tests. Field equipment includes a CME Model 55 drill rig with soil sampling, rock coring, and cone penetration equipment and an additional drill rig for obtaining pavement and stabilized subgrade cores. Other field equipment includes a nuclear moisture-density gage, slope inclinometers, tilt meters, pressure cells, strain gage equipment, global satellite position (GPS) equipment and laser equipment for obtaining rock slope and embankment cross-sections.

## *Intelligent Transportation Systems*

In recent years, the Kentucky Transportation Center and the Commonwealth of Kentucky have become recognized nationally as leaders in the field of Intelligent Transportation Systems (ITS). ITS is an extremely broad term referring to any use of advanced technologies to improve surface transportation. The primary technologies involved are those used for detection, information processing, and communications. These technologies are used to improve surface transportation by making it safer, more efficient, and more “environmentally friendly.”

Much of the Center’s early work in ITS was focused on the area of Commercial Vehicle Operations (CVO). This continues to be a major emphasis, but the Center’s ITS efforts have expanded to include other areas of ITS. The following is a list of the Center’s current projects and programs:

### **Advantage CVO**

*Advantage CVO* is an operating electronic screening system for commercial vehicles at 29 weigh stations on Interstate-75 and Canadian Route 401. More than 5,000 trucks representing 130 companies are participating and can be weighed and checked on the Interstate mainline (at highway speeds) rather than having to pull through the weigh station. Kentucky is the lead-state for the multi-state/private partnership. The Center provides project staff and serves as the project’s Operations Center. Efforts are underway to form a new, expanded partnership that will include several additional states and move the project from research and evaluation to real-world deployment.



*Advantage CVO allows an officer at a weigh station to monitor and notify participating vehicles to bypass the weigh station or, if not properly cleared, to pull into the station.*

### **Interstate 65 Electronic Screening Project**

The Center is managing (for the Kentucky Transportation Cabinet and the Indiana DOT) an electronic screening project for commercial vehicles on Interstate-65. Activities include a demonstration installation of “Model MACS,” a simpler and less costly system than that used for *Advantage CVO*. The system should be brought on-line at three northbound weigh stations in 1999. The Model MACS system is intended to be a model for other states wishing to implement a simple, low-cost and interoperable electronic clearance system. The software and system design will be made available to all states.



*CVO equipment on the roadway “communicates” with a transponder on the inside windshield of the vehicle.*

### **CVISN**

Kentucky is one of eight model deployment states for “Commercial Vehicle Information Systems and Networks” (CVISN), the national architecture for ITS/CVO systems and

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**Continued on next page**

services. The Center is assisting the Kentucky Transportation Cabinet in conjunction with the U.S. Department of Transportation to achieve successful deployment of these services including the following:

- ◆ Distribution of safety information to roadside computers to target high-risk carriers.
- ◆ Electronic collection of inspection data from the roadside, uploading to "SAFETYNET."
- ◆ Electronic application for credentials by motor carriers.
- ◆ Interfacing of state systems to clearinghouses for the International Registration Plan (IRP) and the International Fuel Tax Agreement (IFTA).
- ◆ Electronic screening of trucks at weigh stations.
- ◆ A system for remote monitoring of truck traffic on potential weigh station bypass routes.

The Center provides overall management support, case study evaluation, and information materials/media for Kentucky's CVISN program and technical advice and support on projects focused on monitoring and screening trucks.

### **ITS/CVO Mainstreaming**

The Center supports Kentucky as the lead state serving the states of the Great Lakes and Southeast regions as a "regional champion" for improving commercial vehicle operations. The Center works with all the states to arrange a semi-annual discussion forum, document best practices and present case studies, and maintain a web site for information on the status of CVISN. Members of the Center's staff (four persons) were selected to participate in the 15-member national training team that has been established to deliver three specially designed workshop courses to all states seeking to deploy CVISN technologies. Kentucky also was selected to host a series of project planning workshops in Lexington that are aimed at assisting participating states in the development of detailed project plans for their unique deployment of CVISN.

### **Development of an ITS Strategic Plan for Kentucky**

In recognition of the need to ensure that ITS technologies are applied appropriately to transportation projects in Kentucky, a strategic plan is being developed. The overall purpose of the ITS Strategic Plan is to: (1) offer a vision for ITS in Kentucky; and (2) address each of the functional components of ITS separately with sections devoted to mission, vision, goals, applicable technologies, and recommendations for deployment.

A business plan will be developed as a recommended approach to implementation of specific ITS projects in Kentucky. A draft report of the ITS Strategic Plan has been completed for three functional areas of ITS (rural transportation, traveler information, and commercial vehicle operations). Work is underway to identify and recommend specific projects within these three functional areas for implementation of ITS technologies in Kentucky. The remaining areas of ITS (traffic management, public transportation, and vehicle control systems) will be addressed during the next year, as part of the development of a final report on the ITS Strategic Plan. Additional concerns relating to the state's ITS architecture and infrastructure will be addressed.

### **Roadside Identification Feasibility Study**

The Center was recently awarded a project by the Federal Highway Administration to identify and assess available technologies for roadside identification of commercial vehicles. Several such technologies are known to exist, including transponder-based systems (such as those used for *Advantage CVO*), license-plate readers, and other optical character recognition (OCR) systems. The purpose of this study is to identify and assess all of the available technologies, determine which technologies appear to offer the most potential for real-world applications, and provide recommendations to the Federal Highway Administration on future research, development, and testing.



## *Pavements*

The Pavement Section analyzes all problems associated with the pavement and its performance. These factors include construction and rehabilitation costs, long-and short-term performance, weather, subgrade, drainage, heavy loads, construction materials, etc. This Section, along with the Transportation Cabinet, is not just concentrating on building and testing new roads but also is trying to build stronger and longer-lasting roads, reduce construction delay times, increase contractors' responsibility for the end product, and reduce the length of the construction project through innovative thinking and construction bonuses. Current research projects include:

- ◆ Development of ESAL (Equivalent Single Axle Loads) Forecasting Procedures for SUPERPAVE.
- ◆ Cost of Construction Delays and Traffic Control for Life-Cycle Cost Analysis of Pavements.
- ◆ Techniques for Determining Remaining Life of Pavements.
- ◆ Development of Procedures for Determining Levels of QC/QA (Quality Control/Quality Assurance).
- ◆ Improvements to Vehicle Classification Data Collection, Analysis, and Processing.
- ◆ Evaluation of SUPERPAVE.
- ◆ Life Cycle Cost Analysis, Interstates-65 and -75, Widening Projects.
- ◆ Drainage Investigations:
  - ◆ Evaluation of 48-inch Polyethylene Pipe, US 127, Owen County.
  - ◆ Investigate Corrugated Metal Culverts on KY 61, Cumberland County and KY 55, Shelby County.
  - ◆ Investigate Outlet Pipe for Butler State Park Lake.

The Pavements Section continues to apply advanced technology and innovation to evaluate and analyze problems faced by the transportation industry. The Section is currently using advanced infrared scanners to evaluate segregation and the rate of cooling in asphalt pavements during construction. Traffic loading of concrete joints is currently being modeled and simulated through computer modeling and fatigue testing of concrete specimens in the laboratory. The section has added a mobile field office/pipeline inspection trailer to its field fleet. The trailer is equipped with motorized pan and tilt cameras for pipeline inspection. In addition, it also is equipped with all the necessary equipment for entering and inspecting

potentially dangerous confined spaces where air quality is in question.



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*Left photo: Pavement Section personnel, Chelliah Madasamy (left) and Richard Reitenour, observe simulated loading of a PCC joint.*

*Below: Simulated PCC joint taken to failure.*



## Structures

Innovation has always played a vital role in advancing our transportation system. It has manifested itself in safer modes of transportation and highly cost-effective investments of the public funds. The research activities conducted in the Structures Section have led to innovative deployment of advanced fiber-reinforced polymer (FRP) composites technology to infrastructure applications. This new material will be one of the construction materials in the twenty-first century. Furthermore, the research activities conducted in the Structures Section focus primarily on highway bridges, seismic evaluation and retrofit, and vessel and truck impact studies which will lead to safer bridges in the Commonwealth and the nation.

### Current Research

1. **Strengthening Existing Bridges With CFRP Components:** The objective of this study is to evaluate, test, and strengthen existing bridges with carbon fiber reinforced polymer cloth and plates.
2. **High-Performance Composite Material Structures - Phase II:** The objective of this project is to develop carbon fiber reinforced polymer (CFRP) prestressing tendons and reinforcing bars for use in reinforced concrete structures, and to construct and test full scale reinforced and prestressed concrete beams.
3. **Non-Magnetic, Synthetic Aperture Sonar Rail System and Equipment Platform:** The objective of this project is to develop, design, and construct an equipment platform for acoustic testing at the Coastal Systems Station of the Naval Surface Warfare Center in Panama City, Florida, with magnetically transparent components, and preferably nonferrous.
4. **FRP Reinforcing Bars in Bridge Decks:** The objective of this project is to evaluate, test, and construct concrete bridge segments reinforced with glass fiber reinforced polymer rebars, and to deploy the rebars in a bridge deck in Bourbon County.
5. **Full-Depth Bridge Slab Overlay:** The objective of this project is to evaluate the structural effects of full-depth slab overlays on Kentucky's bridges and their viability as a method of rehabilitation for other bridges.
6. **Structural Evaluation of the Roebling Bridge:** The objective of this project is to assess the response of the bridge to current and projected traffic loads.
7. **Bridges With and Without Diaphragms:** The objective of this project is to assess the effectiveness of concrete intermediate diaphragms in prestressed concrete I-girder bridges along coal-haul routes.
8. **Seismic Rating and Evaluation of Highway Structures:** The objective of this project is to generate dynamic site periods due to seismic loading, conduct seismic stability assessments of highway bridge approach embankments and retaining structures, and perform seismic evaluations and analysis of selected truss bridges over the Ohio River.
9. **Vessel and Truck Impact on Bridges:** The objective of this study is to develop design guidelines and charts to guide in the design of bridge piers that are susceptible to impact from barges or trucks.



*UK students, Chris Hill (left) and David Deitz, inspect crack formation on reinforced concrete beam during testing in the Structures Lab.*

## ***Traffic and Safety***

### **Capabilities and Areas of Expertise**

- ◆ Evaluation of highway safety features
- ◆ Accident analysis and investigation
- ◆ Traffic forecasting
- ◆ Highway planning
- ◆ Analysis of traffic control devices and operational features
- ◆ Evaluation of roadway delineation devices and materials
- ◆ Review and analysis of incident management procedures
- ◆ Traffic safety management evaluation



*A fifth-wheel, distance-measuring device was installed on the coal truck during brake tests.*

### **Workshop Subject Areas**

- ◆ Safety features for local roads and streets
- ◆ Work zone traffic control
- ◆ Roadway signs and markings
- ◆ Tourist signing
- ◆ Traffic accident investigation
- ◆ Coal truck driver safety training
- ◆ Roadway incident emergency response
- ◆ Tort liability



*A law enforcement officer assisted with traffic safety as personnel measure skid marks for a research study evaluating coal truck braking.*

### **Accomplishments During the Year**

- ◆ Completion of an interim report on the safety and operation of large trucks.
- ◆ Completion of an interim report on installations of road weather information systems.
- ◆ Completion of a report evaluating the performance of a new guardrail end treatment.
- ◆ Completion of a study and report on the allocation of costs for highways in Kentucky.
- ◆ Completion of an interim report evaluating Kentucky's driver license point system.
- ◆ Completion of reports for the Kentucky State Police on accident rates and safety belts.
- ◆ Prepared proposal and secured funding for study of incident management procedures.
- ◆ Prepared proposal and secured funding for development of a highway reference system.
- ◆ Prepared proposal and secured funding for evaluation of graduated licensing program.
- ◆ Prepared proposal and secured funding for development of a workshop on "Flexibility in Highway Design."

### **Value of Innovation**

The Traffic and Safety Section has been involved in several activities during the past year that demonstrate the value of innovation. Specifically, field tests were conducted using instrumented trucks with resulting developments in the area of truck safety which have proven to be beneficial toward understanding the braking capabilities of coal trucks. Another effort, in partnership with a private research and development firm, was initiated in the field of truck safety to develop a device to measure the stability and rollover propensity of large trucks.

A recent effort has been initiated by the Kentucky Transportation Cabinet and the Transportation Center to introduce the concept of Quality Assurance/Quality Control and aspire to produce performance-based specifications in the areas of highway construction and operations. The objective is to shift more responsibility to the provider of materials and services, while ensuring a high-quality product.

## *Special Projects and Other Research*

The Special Projects Section works in conjunction with other sections to perform quick response studies, product evaluations, unforeseen investigations, and to oversee long-term monitoring on experimental or non-conventional projects. The Section is responsible for the maintenance of all technical records, preparation of biannual and status reports, and the annual work program. Section staff assist other units within the Center in the development of software, data collection and management, and maintenance of computer hardware. The Information Systems Branch provides computational technical assistance to other sections and assists in data storage and maintenance. The long-term monitoring study consists of 27 subtasks. During the year, data were collected on the following subtasks:

- ◆ Subdrainage and edge drains
- ◆ Cracking and reflective cracking
- ◆ Long-span and box culverts
- ◆ Structural paint systems
- ◆ Plastic pipe
- ◆ Guardrail end treatments
- ◆ Roadway delineation
- ◆ AA highway
- ◆ Paint removal
- ◆ Chemical subgrades
- ◆ Breakaway poles
- ◆ Wall systems

This Section coordinates product evaluation for materials and concepts assigned to the Center for study by the Products Evaluation Committee of the Kentucky Transportation Cabinet (KyTC). Recent evaluations have included:

- ◆ Bridge Earthquake Isolation Systems
- ◆ Earth Retaining Wall Systems
- ◆ Guardrail End Treatments
- ◆ Structural Paint Formulations
- ◆ Polyethylene Pipe
- ◆ Chemical Subgrades
- ◆ Pavement Markers
- ◆ Energy Absorbing Systems
- ◆ Retroreflective Sheeting

The Information Systems Branch acts as a liaison between the Center and the Engineering Computing Center to maintain, troubleshoot, and enhance the network capabilities of the Center. It is responsible for installation and maintenance of network hardware and software on Center computers.

The staff also works with the network services at the Kentucky Transportation Cabinet to allow the Center access to information and data on the Frankfort mainframe and various servers in the Cabinet.

The Section is responsible for the system administration for a multi-user Unix system. This includes setting up and maintaining user accounts and groups, adding software, system backup, and disk maintenance.

Other duties of the Information Systems Branch include developing new programs, maintaining and updating existing programs, developing and maintaining the Center's home page on the World Wide Web, and installing, training, assisting, and troubleshooting PC software for the Center's staff.

## *Strategic Change Integration Group*

This newest group of the Center is multidisciplinary: geography, planning, business/economics, public policy, education, library science, and, yes, even engineering is represented among the credentials of its staff. Nearly every project or program focuses on innovation, technology, and change relating to transportation.

Whether designing a new process or applying a new technology, we soon face the challenge of integrating something new into a traditional work environment. The group tends to be close to the bleeding edge of information technology—running Windows NT with ARC/

## *Strategic Change Integration Group (Continued)*

Info and Arcview, managing three web sites (one with a dynamic linked database) and a discussion list serv for a Federal Highway Administration program. Tools for planning and managing change have been developed and support a variety of projects focusing on information technology.

In the field of education and training, the group leads a Transportation Systems Management program for graduate students from several disciplines with year-long fellowships. Several members of the group serve on a national training team for ITS/CVO delivering courses throughout the South and Great Lakes area. One of the web sites ([www.cvoz.uky.edu](http://www.cvoz.uky.edu)) provides a unique analogy to the characters and themes of the Wizard of Oz to convey issues and solutions of using information technology to improve commercial vehicle operations in states. In the area of GIS, the group provides technical assistance and support to GIS (Geographic Information System) activities in the Kentucky Transportation Cabinet. In addition, the group applies GIS and GPS (Global Positioning System) analysis capabilities in support of a variety of projects at the Center, including improved route planning and intermodal planning.

The group fully participates in a major program effort focused on improving commercial vehicle operations both at the desk-side and the roadside. Work of the group supports FHWA (Office of Motor Carriers) CVISN (Commercial Vehicle Information Systems and Networks) deployment, Kentucky Development Cabinet—Department of Vehicle Regulation with its Model Deployment project, and the states of the region interested in improving commercial vehicle operations using ITS and information technology. Along with other staff at the Center, the group has played a major role in the activities cited in the receipt of a national award from ITS America (see “Message from the Transportation Secretary” on page iii.)

## *Construction Related Research Projects*

Members of the Construction Engineering and Management Area of the Civil Engineering Department are currently conducting three construction-related research projects for the Kentucky Transportation Cabinet. A project entering its sixth year is the development of a conceptual cost-estimating model for use in setting the initial cost budget for new Cabinet projects when initiated in the Six-Year Plan. The current system has drawn much concern in the Legislature since so many projects cost more than their original budget. A user-friendly computer model has been developed for the Department of Highways District personnel based on historical cost records of past Cabinet construction projects. Again this year, efforts have been concentrated on the strengthening of the databases with more historical costs, plus training sessions were held with District personnel.

A second project was continued this year to evaluate the innovative contract methods being used on the Paris Pike reconstruction project from Lexington to Paris, Kentucky. Instead of the traditional competitive bid process for the construction, a group of five contractors was prequalified to provide constructibility input on the design process for each phase of the project. Only these prequalified firms are allowed to bid on the actual construction phases of the Paris Pike project. Several other innovative contract provisions are to be used during the construction processes. A study will be made of the final results achieved on the project and compared to results typically attained on Cabinet construction projects performed under the traditional design-bid-build method. This project is one of the most unique highway construction projects ever built in Kentucky. Progress is currently being curtailed due to legal proceedings of some landowners who are opposing the project. Court action is required to resolve the matter before construction can proceed.



## **Research Reports -- 1997 thru 1998**

### **1997**

KTC-97-1	Dynamic Site Periods for Jackson Purchase Region of Western Kentucky
KTC-97-2	Analysis and Design of Bridges Susceptible to Barge Impact
KTC-97-3	Perform. Eval. of Recycled PCC Pavement Used as a Dense-Graded Aggregate
KTC-97-4	Traffic Flow and Safety Evaluation of Fayette County Schools - Part II
KTC-97-5	Performance and Cost-Effectiveness of Pavement Edge Drains
KTC-97-6	Evaluation of Speed Limits in Kentucky
KTC-97-7	Roadway Related Tort Liability and Risk Management, 4th Edition
KTC-97-8	Subsurface Drainage of Highway Pavements
KTC-97-9	Examination of Concrete Cores from Lowe's Store in Carbondale, Illinois
KTC-97-10	Evaluation of Wall Structures in Kentucky
KTC-97-11	Visual Inspection of Keystone Block Wall and Embankment Slide at Mist Lake Plaza in Lexington, Kentucky
KTC-97-12	Report on County Road Finance
KTC-97-13	Cost Estimating and Forecasting for Highway Work in Kentucky
KTC-97-14	Legislation Review and Recommendations to Reduce Evasion of Kentucky Road Fund Revenues
KTC-97-15	Sum. of Results of '95 Field Evaluations of Long Life Pvmnt Marking Materials
KTC-97-16	Evaluation of Pavement Edge Drains and Headwalls on I-264 (Watterson Expressway), Jefferson County
KTC-97-17	1997 Safety Belt Usage Survey and Evaluation of Effectiveness in Kentucky
KTC-97-18	Analysis of Traffic Accident Data in Kentucky (1992-1996)
KTC-97-19	Stabilization of Subgrade Soil Using Hydrated Lime Product
KTC-97-20	Stabilization of an Airport Subgrade using Hydrated Lime and Fly Ash
KTC-97-21	Roadway Incident Emergency Response—Workshop Sum. and Detour Maps
KTC-97-22	Development of a Critical Path Method Specification and a Training Program for Use of CPM for the Kentucky Transportation Cabinet
KTC-97-23	Annual Assessment of Customer Needs and Satisfaction
KTC-97-24	Annual Assessment of Customer Needs and Satisfaction: Mail Survey Report
KTC-97-25	Evaluation of the ET2000 Guardrail End Treatment
KTC-97-26	Evaluation of Road Weather Information Systems

### **1998**

KTC-98-1	Seismic Isolation of a Highly Skewed Prestressed Concrete Girder Bridge
KTC-98-2	Embankment Construction Using Shale
KTC-98-3	1998 Highway Cost Allocation Update Technical Report
KTC-98-4	Use of Hydrated Lime By-product for Stabilization of Subgrade Soils
KTC-98-5	Investigation and Analysis of Heavy Truck Accidents
KTC-98-6	Survey and Visual Inspection of Keystone Block Wall and Embankment Slide at Mist Lake Plaza in Lexington, Kentucky
KTC-98-7	Evaluation of Corrugated Steel Pipe Culverts on KY 61, Cumberland County
KTC-98-8	A Report on County Road Program Finance (Fiscal Year 1996-97)
KTC-98-9	Intelligent Transportation Systems Strategic Plan
KTC-98-10	Evaluation of Condition-Responsive Work Zone Traffic Controls at the I-75 Clays Ferry Bridge
KTC-98-11	Evaluation of Kentucky's Driver License Point System and Retesting Criteria
KTC-98-12	Experimental Analysis and Analytical Modeling of Bridges With and Without Diaphragms
KTC-98-13	Field Performance Report on 48-inch, HDPE on US 127, Owen County
KTC-98-14	A Methodology for Eval. Large Truck Access to Intermodal and Other Facilities
KTC-98-15	1998 Safety Belt Usage Survey and Evaluation of Effectiveness in Kentucky

## ***Expenditures Statement FY 1997-98***

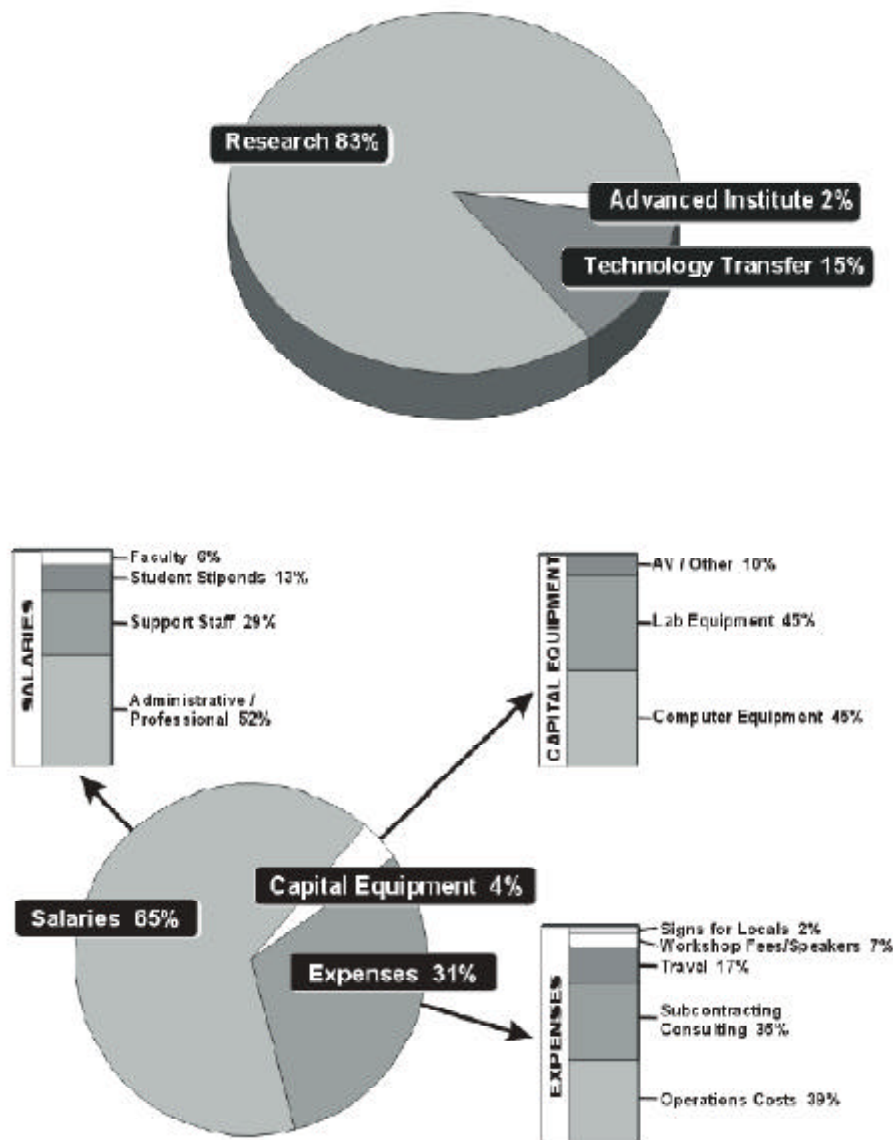
	<b>Technology Transfer</b>	<b>Research</b>	<b>Advanced Institute</b>	<b>Total Program</b>
<b>Salaries</b>				
Admin./Professional	\$200,642	\$1,316,259	\$192	\$1,517,093
Faculty	321	176,434	11,945	188,700
Support Staff	75,231	781,652	1,137	858,020
Student Stipends	4,754	290,997	73,564	369,315
<b>Total Salaries</b>	<b>\$280,948</b>	<b>\$2,565,342</b>	<b>\$86,838</b>	<b>\$2,933,128</b>
<b>Expenses</b>				
Workshop Fees/Speakers	94,798	0	0	\$94,798
Subcontracts/Consulting	58,684	431,647	0	490,331
Operation Costs	206,709	325,754	505	532,968
Signs for Locals	0	34,894	0	34,894
Travel	28,832	190,125	12,147	231,104
<b>Total Expenses</b>	<b>\$389,023</b>	<b>\$982,420</b>	<b>\$12,652</b>	<b>\$1,384,095</b>
<b>Capital Equipment</b>				
Computer Equipment	\$4,079	\$73,910	\$0	\$77,989
Lab Equipment	0	76,688	0	76,688
AV/Other	1,000	16,849	0	17,849
<b>Total Equipment</b>	<b>\$5,079</b>	<b>\$167,447</b>	<b>\$0</b>	<b>\$172,526</b>
TTL Direct Costs	\$675,050	\$3,715,209	\$99,490	\$4,489,749
Indirect Costs	\$10,804	\$782,599	\$5,977	\$799,380
<b>Total Program Expenditures</b>	<b>\$685,854</b>	<b>\$4,497,808</b>	<b>\$105,467</b>	<b>\$5,289,129</b>

*Note: The University contributes approximately 30% indirect cost to the Technology Transfer LTAP program.*



*Structures Section personnel are studying the use of fiber-reinforced glass bars in bridge decks. This photo shows concrete being poured on the Rogers Creek Bridge in Bourbon County using the bars. Researchers will monitor the deck to see how well it performs.*

## *FY 1997-98 Expenditures*





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**Continued on next page**

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*Barry Butcher,  
engineering  
technologist in the  
Geotechnlogy  
Section, uses global  
positioning system  
(GPS) technology  
to locate rockfall  
and landslide sites.*